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UK CL (Edition J) G1F, H4F FAA FDX FGA FGH

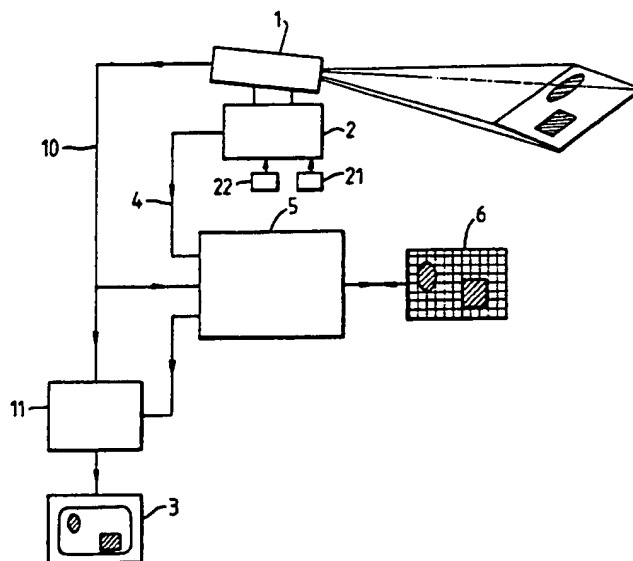
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## (54) Image enhancement of a monochrome camera picture

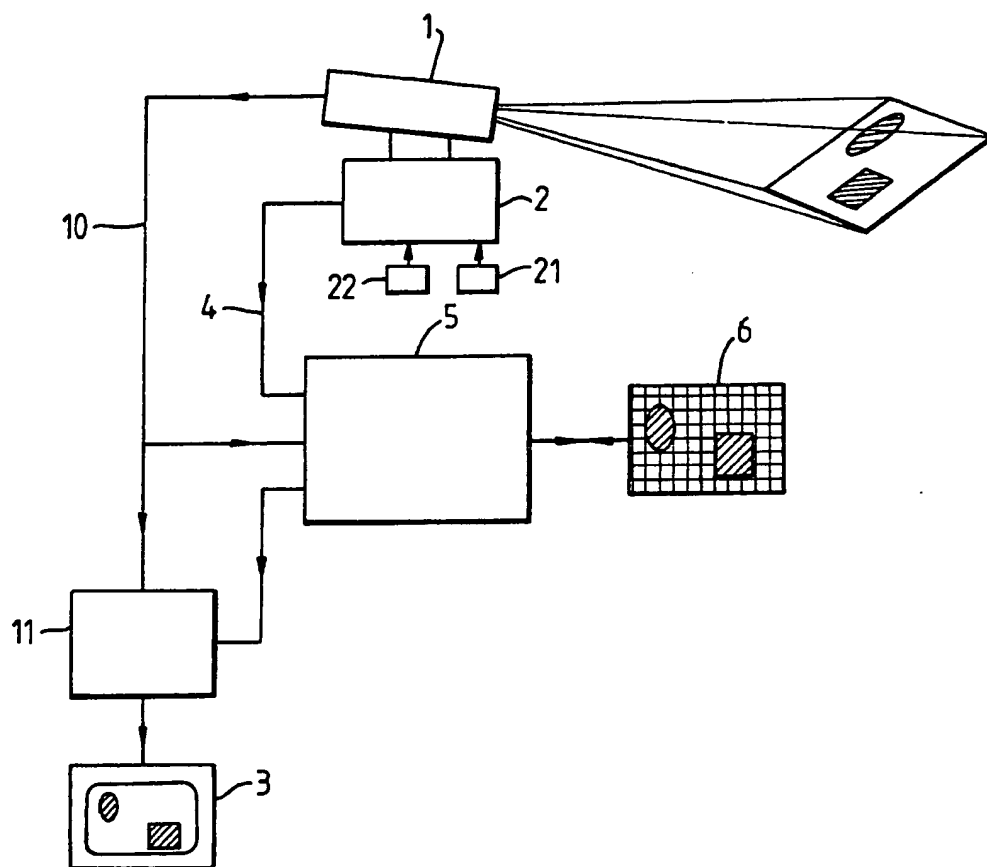
(57) Image enhancement apparatus for an aircraft's infra-red camera 1 or the like includes an environmental database 6 containing information about the geographical features and vegetation in the area over which the aircraft is flying. The camera output is supplied to an overlay unit 11 which also receives the database information correlated at 5 to the pixels of the field-of-view of the camera. The overlay unit 11 colour shades different regions seen by the camera 1 in accordance with the nature of the region as identified in the database and supplies this colour-coded output to a colour display 3. Similar techniques apply for low light cameras and synthetic aperture radar. Image enhancement may be by varying the brightness or flashing selected regions. Printed circuit boards may be viewed similarly with an appropriate database 6.



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## IMAGE ENHANCEMENT APPARATUS AND METHODS

This invention relates to image enhancement apparatus and methods.

The image output provided by some sensors can be difficult to interpret, especially in adverse environments. For example, the output provided by forward-looking infra red cameras (FLIR's), when displayed, appears as a washed-out monochrome image. Although objects of different temperature can be distinguished from one another by their relative brightness, it is difficult to distinguish between regions of the same temperature and to distinguish between, for example, areas of water, forest or arable land. It will be appreciated that when such sensors are used in aircraft, it is highly desirable for the pilot to be able to distinguish between the nature of the ground over which he is flying.

It is an object of the present invention to provide image enhancement apparatus and methods which can be used to improve the nature of the display.

According to one aspect of the present invention there is provided image enhancement apparatus comprising store means for storing cultural information relating to regions within the area, sensor means arranged to view a part at least of said area, display means arranged to provide a visual display representation of said part of said area in accordance with the output of said sensor means, means correlating the information in the store means with regions of the area viewed by the sensor means, and means transferring said cultural information to said display means such that said cultural information is provided within respective regions of the part of the said area represented by the display means by visible enhancement of the respective regions.

The display means is preferably a colour display, the sensor means providing a monochrome output, and the cultural information being provided on the display means by colour-coded shading of the respective regions. The cultural information may alternatively be provided on the display by modification the brightness of the respective regions. The sensor means preferably includes a television camera. The sensor means may be responsive to infra-red radiation. The area may be a geographical area of terrain and the cultural information relating to geographical features and areas of vegetation.

According to another aspect of the present invention there is provided a method of image enhancement comprising the steps of: storing cultural information relating to regions within an area, viewing a part at least of said area with an imaging sensor, providing a visual display representation of said part, correlating the stored information with the regions viewed, and transferring said cultural information to the visual display representation such that the cultural information is provided within respective regions of the part of the area in the display representation by visible enhancement of the respective regions.

The cultural information is preferably provided by colour-coded shading of the respective regions but may alternatively be provided by modifying the brightness of the respective regions.

Image enhancement apparatus for an infra-red camera and its method of operation, in accordance with the present invention, will now be described, by way of example, with reference to the accompanying drawing which shows the apparatus schematically.

The image enhancement apparatus includes a forward-looking infra-red television camera 1 mounted on a platform 2 which supplies image signals to a display 3.

In the present example, the platform 2 is an aircraft, the camera being mounted to view the ground 30 in front of the aircraft. Information is supplied from the platform 2 on line 4 to a computer 5 to identify the area of ground being viewed by the camera. In this respect, the information identifies the location of the aircraft, such as from its navigational system 21, and the attitude of the camera, from the aircraft attitude sensors 22.

The computer 5 is coupled to a conventional environmental database or store 6 which contains information about the area of ground 30 over which the aircraft is flying. In particular, the database 6 contains cultural information about different regions of the area, that is, it identifies whether the regions are forested, arable, water, built-up or the like. This

information is pre-stored in the database from maps and other information about the area. Thus, when the computer 5 identifies a particular region, the database 6 is able to provide information as to the nature of the ground cover in that region. The database may be up-dated if the aircraft moves outside the area covered by the original stored information.

The output from the camera 1 is supplied via line 10 to an overlay unit 11. The camera output is in video form and, without the enhancement provided by the present apparatus, would provide a monochrome display representing the levels of infra-red radiation received by the camera from different regions within its field-of-view.

The overlay unit 11 also receives information from the computer 5 representing the cultural features associated with the individual pixels of the field-of-view of the camera. The overlay unit 11 provides colour-coded shading of the regions within the field-of-view of the camera 1 so that, on the display 3, areas of water are shaded with a blue colour, areas of forest are shaded green, arable areas are shaded yellow and built-up areas are shaded red. It will be appreciated that different colours could be used and that different or additional cultural information could be provided. Instead of using

colour-coding to visibly enhance the displayed regions, this could be achieved by, for example modifying the brightness of the region, or flashing the region, so as to highlight it to the user.

The computer 5 acts as a correlator to perform geometrical calculations of a known kind from the information received on line 4 and from the output signals from the camera 1 identifying the location of the pixel in scan of the camera. These calculations transform the pixel in the field-of-view of the camera 1 to the equivalent region in the database 6 so that the cultural information about the region is read out to the overlay unit 11.

The display 3, which may be provided on a colour CRT or flat panel display as a head-down or head-up display, provides the pilot of the aircraft with an enhanced image display. The pilot is able to identify readily whether he is flying over water or land and is able to distinguish more readily the boundaries between regions with different ground cover. This makes it far easier for the pilot to navigate by sight at night and in poor visibility.



The apparatus and method of the invention is not confined to use with sensors viewing geographical areas but could, for example, be used in inspection apparatus. For example, when inspecting printed circuit board assembly, the database could contain cultural information about the nature of the components that should be located in a particular region of the board and this information could then be utilized to colour shade the display so that different components stand out clearly from the background.

The sensor used need not be an infra-red camera but could, for example, be a low-light level television camera or a synthetic aperture radar.

CLAIMS

1. Image enhancement apparatus comprising store means for storing cultural information relating to regions within an area, sensor means arranged to view a part at least of said area, display means arranged to provide a visual display representation of said part of said area in accordance with the output of said sensor means, means correlating the information in the store means with regions of the area viewed by the sensor means, and means transferring said cultural information to said display means such that said cultural information is provided within respective regions of the part of the said area represented by the display means by visible enhancement of the respective regions.
2. Image enhancement apparatus according to Claim 1, wherein the display means is a colour display, wherein the sensor means provides a monochrome output, and wherein the cultural information is provided on the display means by colour-coded shading of the respective regions.

3. Image enhancement apparatus according to Claim 1, wherein the cultural information is provided on the display means by modification of the brightness of the respective regions.
4. Image enhancement apparatus according to any one of the preceding claims, wherein the sensor means includes a television camera.
5. Image enhancement apparatus according to any of the preceding claims, wherein the sensor means is responsive to infra-red radiation.
6. Image enhancement apparatus according to any of the preceding claims, wherein the area is a geographical area of terrain and the cultural information relates to geographical features and areas of vegetation.
7. Image enhancement apparatus substantially as hereinbefore described with reference to the accompanying drawing.

8. A method of image enhancement comprising the steps of: storing cultural information relating to regions within an area, viewing a part at least of said area with an imaging sensor, providing a visual display representation of said part, correlating the stored information with the regions viewed and transferring said cultural information to the visual display representation such that the cultural information is provided within respective regions of the part of the area in the display representation by visible enhancement of the respective regions.
9. A method according to Claim 8, wherein the cultural information is provided by colour coded shading of the respective regions.
10. A method according to Claim 8, wherein the cultural information is provided by modifying the brightness of the respective regions.
11. A method of image enhancement substantially as hereinbefore described with reference to the accompanying drawings.
12. Any novel feature or combination of features as hereinbefore described.